REMARKS

Claims 1, 3-5 and 8-10 remain pending in the present application.

Rejection under 35 U.S.C. §102(e) over Allen

Claims 1, 3, 5, 8 and 10 stand rejected under 35 U.S.C. §102(e) over Allen (U.S. Publication no. 2002/0125601 A1). Applicants traverse this basis for rejection and respectfully request reconsideration and withdrawal thereof.

Applicants submit herewith a copy of U.S. Serial no. 60/223,040 (the '040 provisional), filed 4 August 2000 (now U.S. Serial no. 09/915,688), in which Applicants disclose melt blowing dies useful according to the present application. Of particular import are Figs. 1, 3 and 5 of Applicants' provisional application, which disclose a unitary, post-coalescent melt blowing beam die. Accordingly, it is clear that Applicants invented said post-coalescent melt blowing beam die prior to the filing date of Allen, 9 March 2001. Notably, Applicants disclose that the invention of the '040 provisional utilizes "separately controlled multiple extruders" (page 4, lines 20-22) to feed the inventive die.

Allen discloses an apparatus for extruding single-component strands into multi-component strands, which comprises such a unitary, post-coalescent die tip (Fig. 3, item 58), useful for melt blowing [0025], which is used in combination with a dual coathanger manifold polymer distribution system [0027].

However, Applicants also enclose herewith a translation of JP2-289107 (JP '107) (publication date 29 November 1990), which clearly discloses a dual coathanger meltblowing apparatus (Figs. 1-3), essentially as disclosed by Allen, having a unitary die tip configured for pre-coalescence meltblowing.

As such, the only advance of Allen over the well-established prior art of JP '107 is the reconfiguration of the die tip to be a post-coalescence die tip, which Applicants invented prior to Allen, as demonstrated by their provisional patent application no. 60/223,040.

> [Applicants] should not be required to submit facts under Rule 131 showing that they reduced to practice that which is obvious in addition to those facts offered as showing a completion of the invention, for the purpose of antedating a reference. <u>In re Hostettler</u>, 356 F. 2d 562, at 565-67; 148 USPQ 514 (CCPA 1966); <u>In re Spiller</u>, 500 F. 2d 1170, 182 USPQ 614(CCPA 1974).

Withdrawal of Allen as a reference under 35 U.S.C. §102(e) is requested. Since Applicants' provisional application is on file in the USPTO, with an established filing date prior to the cited reference, Applicants do not believe it necessary to submit

a Declaration under 37 CFR 1.131 to establish a date of inventorship of the die tip prior to Allen. However, Applicants will resubmit this information in the form of a declaration upon request by the Examiner.

Rejection under 35 U.S.C. §103(a) over Allen

Claims 1, 3, 5, 8 and 10 stand rejected under 35 U.S.C. §103(a) over Allen. Applicants traverse this basis for rejection and respectfully request reconsideration and withdrawal thereof.

For the reasons stated above, Applicants submit that Allen should be withdrawn as a reference under 35 U.S.C. §102(e), and is therefor unavailable under 35 U.S.C. §103(a).

Rejection under 35 U.S.C. §103(a) over Groten et al. in view of Buehning

Claims 1, 3-5 and 8-10 stand rejected under 35 U.S.C. §103(a) as obvious over Groten et al. in view of Buehning. Applicants traverse this basis for rejection and respectfully request reconsideration and withdrawal thereof.

The disclosures of Groten et al. and Buehning have been discussed at length in Applicants' previous responses.

In item 5 of the outstanding Office Action, the Examiner opines that it would have been obvious to modify the equipment of Buehning to for multicomponent filaments to form the fibers of Groten et al. Applicants presume that it is the Examiner's position that it would have been obvious to substitute the fiber spinning dies of Groten et al. for the die tip of Buehning (Fig. 3, item 50).

Closer examination of the Groten et al. reference reveals that the die plates disclosed therein are cylindrical in shape: Fig. 1 and Fig. 8, described in paragraphs [0010] and [0017] respectively. Such cylindrical die plates could not be substituted into the Buehning apparatus, since the meltblowing dies of Buehning are formed of

> a rectangular cross-section base portion having an upper surface 102, right angle sides 104 and a bottom surface 105...[having] a triangular-shaped die tip nose 108. (Col. 5, lines 20-25).

The melt blowing dies of Buehning run the full length of his assembly (col. 5, lines 13-17). Therefore, the skilled artisan would not have looked to Groten et al. to modify the Buehning apparatus, nor to the Buehning apparatus to supply the die plates of Groten et al.

Withdrawal of the rejection for failure to establish a *prima facie* case of obviousness is requested.

Alternatively, even if *aruendo*, the skilled artisan would have been motivated to attempt to substitute the die plates of Groten et al. for the meltblowing dies of Buehning, such substitution would not have been successful in obtaining an apparatus nor process of the present invention.

> To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on the applicant's disclosure. MPEP § 2142, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Applicants respectfully submit that the skilled artisan could not have had a 'reasonable expectation of success' in obtaining the claimed invention from the proposed combination of references, and therefore no *prima facie* case of obviousness has been established.

In view of the foregoing, allowance of the above-referenced application is respectfully requested.

Respectfully submitted,

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Enclosures

TITLE OF INVENTION

MELTBLOWN WEB

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to multicomponent meltblown fibers, multicomponent meltblown fiber webs, and composite nonwoven fabrics that include multicomponent meltblown fibers. The meltblown webs of the invention can be incorporated in composite fabrics suited for use in apparel, wipes, hygiene products, and medical wraps.

Description of Related Art

In a meltblowing process, a nonwoven web is formed by extruding molten polymer through a die and then attenuating and breaking the resulting fibers with a hot, high-velocity gas stream. In the production of a web comprised of meltblown fibers, it is sometimes desirable to form the fibers from more than one polymeric material where each material can have different physical properties and contribute different characteristics to the meltblown web. A conventional way to form such fibers is through a spinning process where the polymeric materials are combined in a molten state within the die cavity and are extruded together as a multicomponent polymer melt through a single spin orifice as described in U.S. Patent no. 6,057,256, which discloses the meltblowing of side-by-side bicomponent fibers onto a collector to form a coherent entangled web.

However, this method has significant limitations due to the compatibility constraints placed on the selection of the polymeric materials such that they will spin well together.

Meltblown fibers have been incorporated into a variety of nonwoven fabrics including composite laminates such as spunbond-meltblown-spunbond ("SMS") composite sheets. In SMS composites, the exterior layers are spunbond fiber layers that contribute strength to the overall composite, while the core layer is a meltblown fiber layer that provides barrier properties

There is a need to provide a new method for forming meltblown fibers, and corresponding meltblown webs, that is more suitable for producing multicomponent meltblown fibers, as the processing conditions for each polymeric component can be optimized individually.

BRIEF SUMMARY OF THE INVENTION

The present invention is directed to a process for forming a plurality of multiple component meltblown fibers comprising extruding a first melt-processable polymer through a first extrusion orifice, simultaneously extruding a second melt-processable polymer through a second extrusion orifice, fusing said first and second melt-processable polymers into an extruded composite filament after extrusion, and pneumatically attenuating and breaking said extruded composite filament with jets of high velocity gas so as to form said plurality of multiple component meltblown fibers.

A second embodiment of the present invention is directed to an extrusion die for meltblowing molten polymers comprising at least two separate polymer supply ports entering from an entrance portion of the die, said polymer supply ports communicating with separate extrusion capillaries having exit openings at an exit portion of the die, a plurality of gas supply ports entering from the entrance portion of the die and arranged concentrically around said polymer supply ports, said gas supply ports communicating with gas jets extending through the die and arranged concentrically around the exit openings of said extrusion capillaries, wherein said extrusion capillary exit openings and said gas jets communicate with a blowing orifice in the exit portion of the die.

In a third embodiment, the present invention is directed to an extrusion die for meltblowing molten polymers comprising a row of die orifices each comprising at least two separate polymer supply ports entering from an entrance portion of the die, each of said polymer supply ports communicating with separate extrusion capillaries having exit openings at an exit portion of the die, gas supply ports entering from the entrance portion of the die and arranged laterally to said polymer supply ports, said gas supply ports communicating with gas jets extending through the die and arranged laterally to the exit openings of said extrusion capillaries, wherein said extrusion capillary exit openings and said gas jets communicate with a blowing orifice in the exit portion of the die.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic longitudinal cross-section of a die according to the second embodiment of the present invention or a single die orifice according to the third embodiment of the present invention, used for producing meltblown fibers for use in nonwoven fabrics according to the process of the present invention.

Figure 2 is an end view of the exit of the die of Fig. 1 according to the second embodiment of the invention.

Figure 3 is an illustration of the die of Fig. 1 in use in the process of the present invention.

Figure 4 is an end view of the exit of an alternative design for a die according to the second embodiment of the invention illustrated in Fig. 1.

Figure 5 is an end view of the exit of the third embodiment of the invention of a die according to Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed toward a method for forming multicomponent meltblown fibers and multicomponent meltblown webs.

The term "polyolefin" as used herein, is intended to mean any of a series of largely saturated open chain polymeric hydrocarbons composed only of carbon and hydrogen atoms. Typical polyolefins include polyethylene, polypropylene, polymethylpentene and various combinations of the ethylene, propylene, and methylpentene monomers.

The term "polyethylene" as used herein is intended to encompass not only homopolymers of ethylene, but also copolymers wherein at least 85% of the recurring units are ethylene units.

The term "polyester" as used herein is intended to embrace polymers wherein at least 85% of the recurring units are condensation products of dicarboxylic acids and dihydroxy alcohols with linkages created by formation of ester units. This includes aromatic, aliphatic, saturated, and unsaturated di-acids and di-alcohols. The term "polyester" as used herein also includes copolymers (such as block, graft, random and alternating copolymers), blends, and modifications thereof. A common example of a polyester is poly(ethylene terephthalate) which is a condensation product of ethylene glycol and terephthalic acid.

The term "meltblown fibers" as used herein, means fibers formed by extruding a melt-processable polymer through a plurality of fine, usually circular, capillaries as molten threads or filaments into a high velocity gas (e.g. air) stream. The high velocity gas stream attenuates the filaments of molten thermoplastic polymer material to reduce their diameter to between about 0.5 and 10 microns. Meltblown fibers are generally discontinuous fibers. Meltblown fibers carried by the high velocity gas stream are generally deposited on a collecting surface to form a web of randomly dispersed fibers.

The term "bicomponent" as used herein refers to any filament, fiber or web that is composed of at least two distinct polymers, but should be understood to encompass such articles which contain more than two distinct polymers. The at

least two polymer components useable herein can be chemically the same polymer, but having different physical characteristics, such as intrinsic viscosity, melt viscosity, die swell, and melting point or softening point. For example, the two components may be linear low density polyethylene and high density polyethylene.

The term "meltspun" or "spunbond" fibers as used herein means fibers which are formed by extruding molten thermoplastic polymer material as filaments from a plurality of fine, usually circular, capillaries of a spinnerette with the diameter of the extruded filaments then being rapidly reduced. Meltspun fibers are generally continuous and have an average diameter of greater than about 5 microns.

The term "nonwoven fabric, sheet or web" as used herein means a structure of individual fibers or threads that are positioned in a random manner to form a planar material without an identifiable pattern, as opposed to a knitted fabric.

The term "multiple component meltblown web" as used herein means meltblown fibers containing multiple and distinct polymer components, where molten filaments are attenuated by a high velocity gas stream and deposited on a collecting surface as a web of randomly dispersed fibers.

Figure 1 illustrates an extrusion die for use in the meltblowing process of this invention, which for simplicity illustrates a two component system. Separately controlled multiple extruders (not shown) supply individual melted polymer streams A and B to a die 10 through polymer supply ports 15a and 15b, where the polymers pass through separate extrusion capillaries 16a and 16b, which in a preferred embodiment are angled within the die so as to direct the individual polymer streams toward a common longitudinal axis. However, the extrusion capillaries may be parallel to one another, but in close enough proximity to each other so as to promote coalescence of the molten polymer streams after exiting from the individual extrusion capillaries. The exits of these capillaries in the die tip 11 are positioned so as to promote the coalescence of the polymers as they exit the die tip through blowing orifice 30 and are fiberized to form a curtain of filaments by a blowing gas, supplied to the die through gas inlets 20, and delivered to gas jets 21, which also are directed toward the common longitudinal axis of the melted polymer streams exiting through the tips of the extrusion capillaries 16a and 16b. In this process, through the use of separately controlled extruders for the different polymers, it is possible to individually control the processing parameters, such as temperature, capillary diameter and extrusion

pressure, for each polymer so as to optimize the extrusion of the individual polymers and yet still form single fibers that comprise both polymers.

Figure 2 is an end view of the exit of die tip 11, which is shown as the smaller-diameter planar surface of a frustum, illustrating the preferred side-by-side configuration of the extrusion capillary exit tips 16a and 16b, which deliver the molten polymer filaments into an inverted cone of high velocity gas formed by gas jets 21, arranged concentrically around the capillary exit tips.

Figure 3 is an illustration according to Fig. 1 which demonstrates the operation of the process of the present invention through extrusion die 10. Polymers A and B are separately delivered through extrusion ports 15a and 15b, respectively, and are forced into extrusion capillaries 16a and 16b. An extruded filament 40a of polymer A and an extruded filament 40b of polymer B exit the extrusion capillary tips, where it is believed the lateral component of the force created by gas jets 21 acts to promote coalescence the two polymers into a bicomponent filament 40. Nearly simultaneously, the longitudinal component of the force created by gas jets 21 acts to attenuate or stretch the filaments, such that the diameter of the stretched bicomponent filament is reduced to about 10 microns or less, and the bicomponent filament is broken as it exits the blowing orifice 30 to form a curtain of fine bicomponent meltblown fibers 41.

Figure 4 is an end view of the exit of die tip 11, modified to practice an alternative embodiment of the present process, so as to form bicomponent sheath-core fibers. In this embodiment, polymer A is extruded through a central extrusion capillary 16c, and polymer B is extruded through a series of extrusion capillaries, exiting the die through a series of curved slots 16d, arranged concentrically around the tip of capillary 16c.

Figure 5 is an end view of the exit of the die according to Fig. 1, wherein a series of die orifices, 16a and 16b, are arranged in a row and extrude the molten polymers into gas jets exiting through slots 21, in combination forming the blowing orifice 30.

The skilled artisan will recognize that the configurations and shapes of the extrusion capillaries can be modified in numerous ways for various reasons. For example, by machining pie-slice shaped cross-sections in the die tip, the process is able to accommodate delivering more than two polymer components into the fibers to form fibers having a substantially circular cross-section with pie-shaped component cross-sections. Likewise, those skilled in the art will recognize that on a production scale, it can be necessary to use many extruder/die apparatuses ("spin blocks") in order to obtain full coverage of the collection surface so as to produce an acceptable non-woven web or fabric.

An advantage in practicing the process of the present invention lies in being able to separately control extrusion parameters for the different polymer components. Since each different polymer is delivered through a different extrusion device, in the event that one polymer component has significantly different physical characteristics than does the other polymer component, such as intrinsic viscosity, melt viscosity, die swell, or melting/softening point, extrusion parameters such as temperature, pressure and even extrusion capillary diameter may be varied to accommodate and optimize the extrusion for each polymer.

It should be understood that the melt-processable polymers useful in the process of the present invention include any polymer capable of being melt-processed, such as thermoplastics including polyesters, polyolefins, polyamides, such as the nylon-type polymers, urethanes, vinyl polymers, such as the styrene-type polymers, fluoropolymers such as ethylene-tetrafluoroethylene, vinylidene fluoride, fluorinated ethylene-propylene, perfluoro (alkyl vinyl ethers) and the like. A preferred combination of polymers for forming the bicomponent meltblown fibers and bicomponent meltblown webs according to the present process is polyethylene and poly(ethylene terephthalate). It is expected that some thermosetting polymers can be used in the process of the present invention, if they remain molten during the process of the invention.

Conventionally, the fibers are deposited on a collecting surface, such as a moving belt or screen, a scrim, or another fibrous layer. Fibers produced by melt blowing are generally discontinuous fibers having an effective diameter in the range of about 0.5 to about 10 microns. As used herein, the "effective diameter" of a fiber with an irregular cross section is equal to the diameter of a hypothetical round fiber having the same cross sectional area.

Without wishing to be bound by theory, it is believed that the gas jets can fracture the filaments into even finer filaments. The resulting filaments are believed to include bicomponent filaments in which each filament is made of at least two separate polymer components that both extend the length of the meltblown fiber in a side-by-side configuration. It is also believed that some of the fractured filaments can contain just one polymer component.

The fibers in the multiple component meltblown web of the invention are typically discontinuous fibers having an average effective diameter of between about 0.5 microns and 10 microns, and more preferably between about 1 and 6 microns, and most preferably between about 2 and 4 microns. Multiple component meltblown webs are formed from at least two polymers simultaneously spun from a spin block incorporating extrusion dies such as those illustrated in the Figures herein. Preferably, the multiple component meltblown

web is a bicomponent web made from two or more polymers. The configuration of the fibers in the bicomponent web is preferably a side-by-side arrangement in which most of the fibers are made of two side-by-side polymer components that extend and are bonded for a significant portion of the length of each fiber. Alternatively, the bicomponent fibers may have a sheath/core arrangement wherein one polymer is surrounded by another polymer, circular in cross-section with pie-shaped slices of more than two different polymers, or any other conventional bicomponent fiber structure. In a more preferred embodiment, the lower melting polymer is located along a portion of the surface of the fiber so as to enhance bonding between the meltblown fibers on the collecting surface.

According to a preferred embodiment of the invention, a low intrinsic viscosity polyester polymer and polyethylene are combined to make a meltblown bicomponent web in the meltblown web production apparatus. The two polymers A and B are melted, filtered, and then metered into the spin block. The melted polymers are extruded through separate extrusion capillaries within the spin block and exit the spin block through an orifice, where they come into contact with gas from the gas jets and are forced into contact with each other, attenuated in the longitudinal direction and broken into discrete fibers having high aspect ratios. Preferably, the gas jets generate the desired side-by-side fiber filament cross-section.

A composite nonwoven fabric incorporating the bicomponent meltblown web described above can be produced in-line by collecting the bicomponent meltblown fibers on a different fabric such as a spunbond fabric. Alternatively, the layers of the composite sheet can be produced independently and later combined and bonded to form the composite sheet. It is also contemplated that more than one spunbond web production apparatus could be used in series to produce a web made of a blend of different single or multiple component fibers. Likewise, it is contemplated that more than one meltblown web production apparatus could be utilized in series in order to produce composite sheets with multiple meltblown layers. It is further contemplated that the polymer(s) used in the various web production apparatuses could be different from each other. Where it is desired to produced a composite sheet having just one spunbond layer and one fine fiber layer, the second spunbond web production apparatus can be turned off or eliminated.

Optionally, a fluorochemical coating can be applied to the composite nonwoven web to reduce the surface energy of the fiber surface and thus increase the fabric's resistance to liquid penetration. For example, the fabric may be treated with a topical finish treatment to improve the liquid barrier and in

particular, to improve barrier to low surface tension liquids. Many topical finish treatment methods are well known in the art and include spray application, roll coating, foam application, dip-squeeze application, etc. Typical finish ingredients include ZONYL® fluorochemical (available from DuPont, Wilmington, DE) or REPEARL® fluorochemical (available from Mitsubishi Int. Corp, New York, NY). A topical finishing process can be carried out either in-line with the fabric production or in a separate process step. Alternatively, such fluorochemicals could also be spun into the fiber as an additive to the melt.

TEST METHODS

In the description above and in the examples that follow, the following test methods were employed to determine various reported characteristics and properties. ASTM refers to the American Society for Testing and Materials.

Fiber Diameter was measured via optical microscopy and is reported as an average value in microns.

Basis Weight is a measure of the mass per unit area of a fabric or sheet and was determined by ASTM D-3776, which is hereby incorporated by reference, and is reported in g/m^2.

Grab Tensile Strength is a measure of the breaking strength of a sheet and was conducted according to ASTM D 5034, which is hereby incorporated by reference, and is reported in Newtons.

WHAT IS CLAIMED IS:

1. A process for forming a plurality of multiple component meltblown fibers comprising extruding a first melt-processable polymer through a first extrusion orifice, simultaneously extruding a second melt-processable polymer through a second extrusion orifice, fusing said first and second melt-processable polymers into an extruded composite filament after extrusion, and pneumatically attenuating and breaking said extruded composite filament with jets of high velocity gas so as to form said plurality of multiple component meltblown fibers.

2. The process according to claim 1, wherein said first and second melt-processable polymers have different viscosities as a function of temperature.

3. The process according to claim 1, wherein said first and second melt-processable polymers have different melting and/or softening points.

4. The process according to claim 1, wherein said first and second melt-processable polymers are chemically different polymers.

5. A non-woven fabric web produced by collecting the meltblown fibers according to claim 1 on a collecting surface.

6. An extrusion die for meltblowing molten polymers comprising a row of die orifices each comprising at least two separate polymer supply ports entering from an entrance portion of the die, each of said polymer supply ports communicating with separate extrusion capillaries having exit openings at an exit portion of the die, gas supply ports entering from the entrance portion of the die and arranged laterally to said polymer supply ports, said gas supply ports communicating with gas jets extending through the die and arranged laterally to the exit openings of said extrusion capillaries, wherein said extrusion capillary exit openings and said gas jets communicate with a blowing orifice in the exit portion of the die.

7. An extrusion die for meltblowing molten polymers comprising at least two separate polymer supply ports entering from an entrance portion of the die, said polymer supply ports communicating with separate extrusion capillaries having exit openings at an exit portion of the die, a plurality of gas supply ports entering from the entrance portion of the die and arranged concentrically around said polymer supply ports, said gas supply ports communicating with gas jets extending through the die and arranged concentrically around the exit openings of

said extrusion capillaries, wherein said extrusion capillary exit openings and said gas jets communicate with a blowing orifice in the exit portion of the die.

8. The extrusion die according to either of claims 6 or 7, wherein said extrusion capillaries are angled toward a common longitudinal axis.

ABSTRACT OF THE DISCLOSURE

A process for forming a plurality of multiple component meltblown fibers comprising extruding a first melt-processable polymer through a first extrusion orifice, simultaneously extruding a second melt-processable polymer through a second extrusion orifice, fusing said first and second melt-processable polymers into an extruded composite filament after extrusion, and pneumatically attenuating and breaking said extruded composite filament with jets of high velocity gas so as to form said plurality of multiple component meltblown fibers.

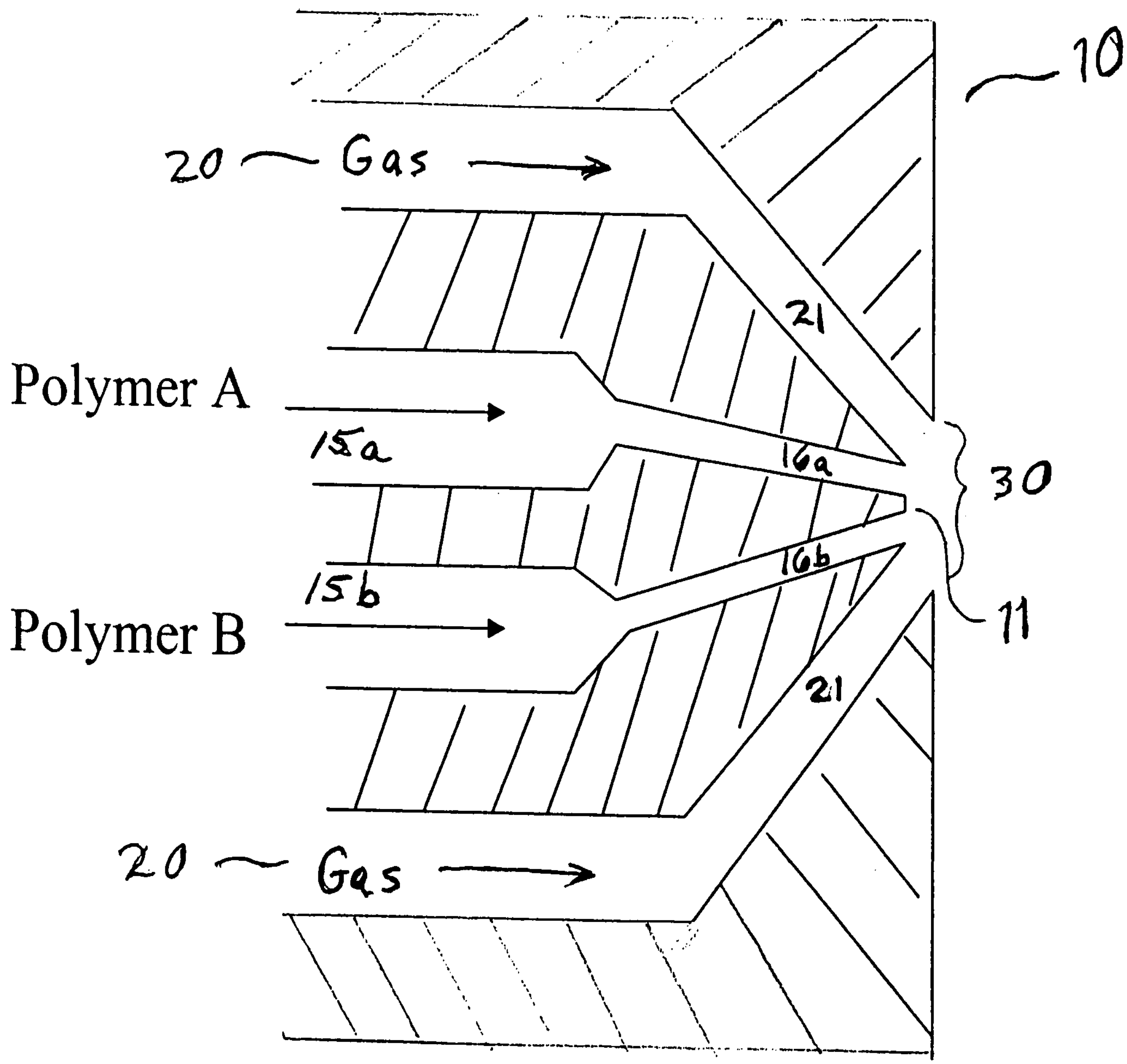

FIG. 1

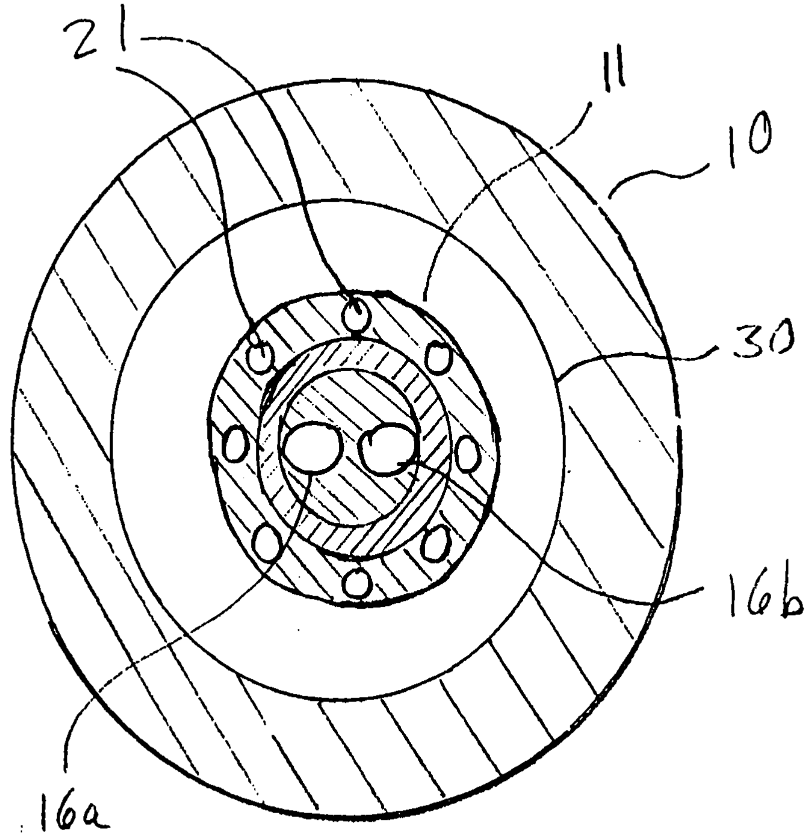

FIG. 2

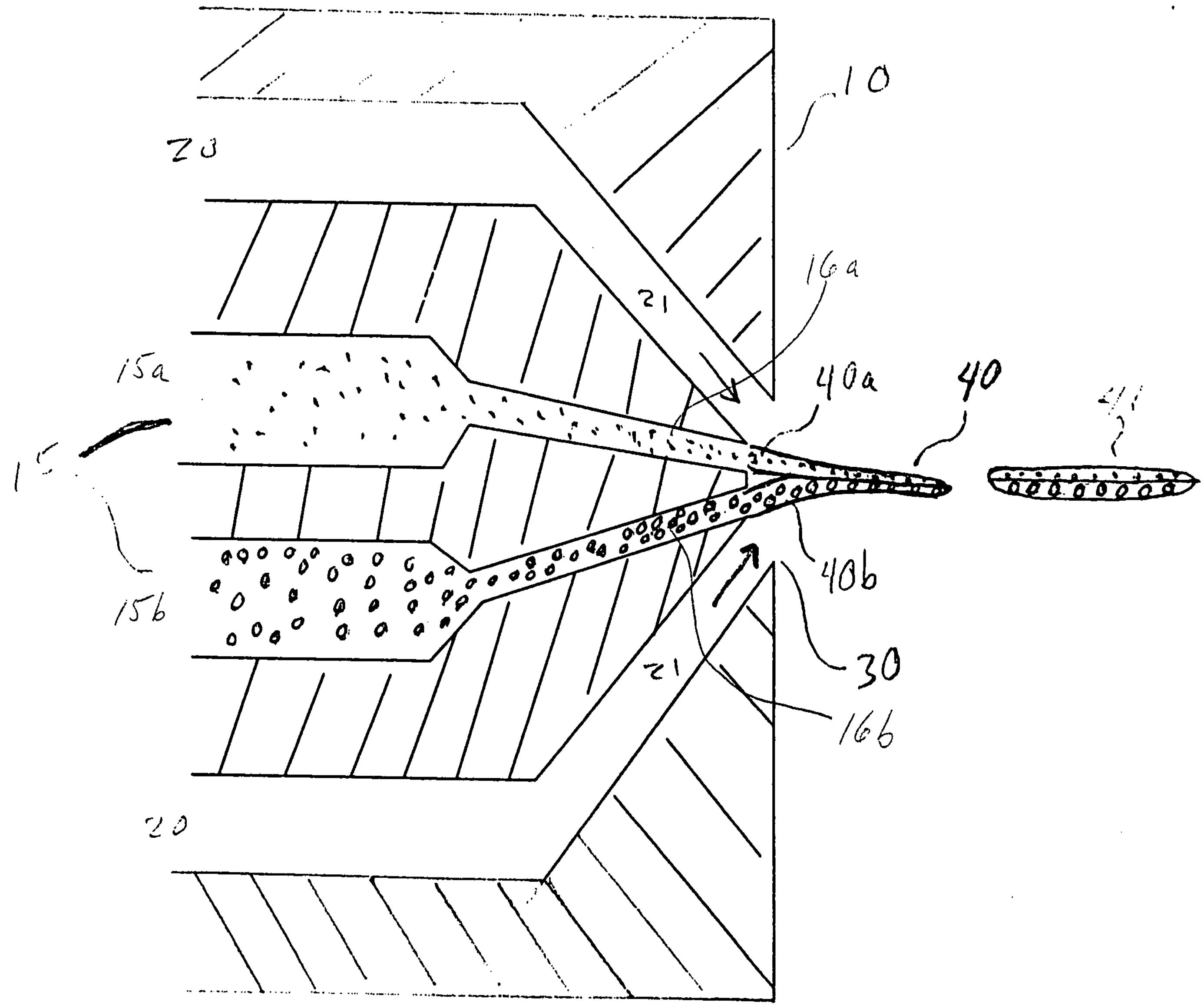

FIG. 3

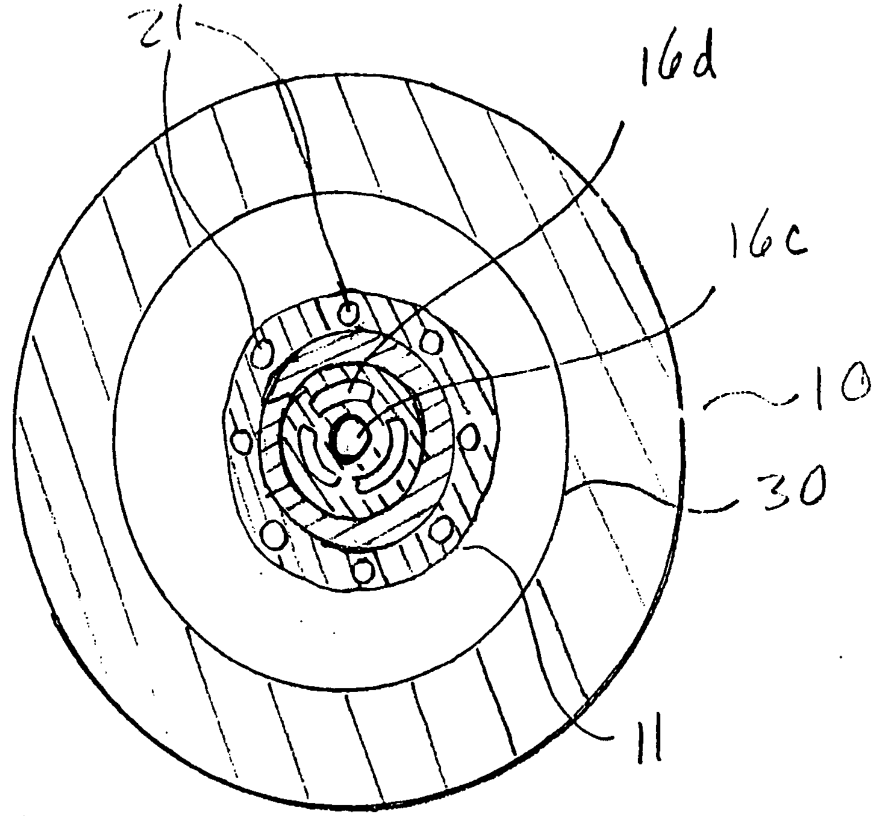

FIG 4

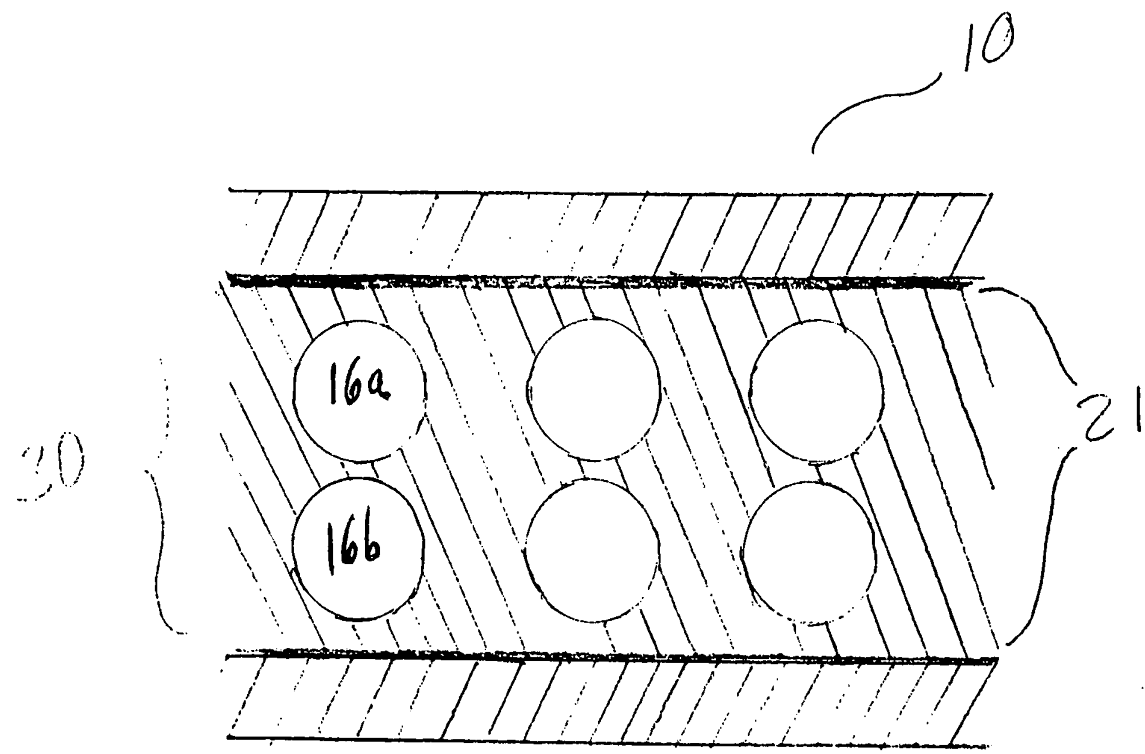

FIG. 5